Candidate plants to help soil pest control in conservation agriculture. Potential effects of 21 species used as cover crops in Madagascar

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Introduction

Cover crops may contribute to crop pest and disease control (Ratnadass et al., 2010). In Madagascar 21 cover crop species are used in upland rice based CA cropping systems (Table 1). These cover crops were selected mainly according to their capacity to fulfil the functions cited above. The reduction of pest impact was not considered, although pests such as "white grubs" and "black beetles" (Col., *Scarabaeidae*) are major constraints in conventional and CA upland cropping systems in the Madagascan highlands (Randriamanantsoa et al.; Ratnadass et al., 2006). A literature review was therefore conducted to assess the potential use of these 21 cover crops to reduce the impact of pests on cropping systems.

Methodology

The review analysed 38 scientific sources from the ScienceDirect®database and CIRAD library. The mechanisms of action of the plants were reported following the typology of effects proposed by Ratnadass et al. (2010)(Figure 1), namely: (A) temporal pest/pathogen cycle disruption via non-host effects; (B) resource concentration/dilution and spatial disruption of pest dynamics/pathogen epidemics; (C) pest deterrence or repellence; (D) pest stimulation or attraction; (E) below-ground allelopathic effects; (F) stimulation of soil pest-pathogen antagonists; (G) crop physiological resistance via improved nutrition; (H) effects via provision of alternative food to natural enemies of crop pests; (I) effects via provision of refuges/shelters for predators due to vegetative structural/architectural characteristics; (J) effects via microclimate alteration; (K) physical barrier effects.

Table I:Inventory of actions of 21cover crops used in Madagascar on crops pests, references from literature**.** Effective part of plant : R : roots; S : shoot/stem; L : leaves; MD: missing data, i.e. unknown. Mechanisms : A, B, C, D, E, F ,G, H, J, K (see methodology).

Cover crop	Pest targeted		Effective part of the plant	Mechanisms	References
Familly -Specie	Type	Name			
A. pintoï, A. repens	Nematoda	*P.loosi, M. incognita, M. paranaensis, R. reniformis*	MD	Unknown	(Luc et al., 2005)
	Insecta	*D. abbreviatus*	S, L	K	(LaPointe, 2003)
	Insecta	*C. bergi*	S, L	A	(Riis et al., 2005)
C. cajan	Nematoda	*M. incognita , M. javanica, R. reniformis, H. cajani, P. zeae, P. sudanensis.*	R	A	(Luc et al., 2005 ; Regnault-Roger et al., 2002; Sharma et al., 1993 ; Sharma et al., 2000 ; Spurthi, 2009)
	Insecta	*Spodoptera exigua*	MD	Unknown	(Spurthi, 2009)
C. grahamiana, C. spectabilis, C. juncea	Nematoda	*M. incognita, M. arenaria, M. javanica, R. reniformis, P. brachyurus, P. zeae, P. coffeae, R. similis*	R, L	A, E, F, G	(Luc et al., 2005; McSorley, 1999; Regnault-Roger et al., 2002; Wang et al., 2003)
D. uncinatum	Nematoda	*H. genera, Meloidogyne spp.*	MD	Unknown	(Luc et al., 2005)
	Insecta	*Busseola fusca, Chilo partellus*	S, L	C, G,	(Khan et al., 2001; Khan et al., 2008; Khan et al., 2000)
M. pruriens	Nematoda	*B. longicaudatus, P. minor, Criconemella ssp., Scutellonema ssp., H. glycines, T. claytoni, M. incognita, M. javanica, P. brachyurus, Ditylenchus sp, Aphelenchoides sp, A. avena, Tylenchus sp , R. reniformis*	R, L	E, F, J	(Blanchart et al., 2006 ; Quénéhervé et al., 1998)
V. unguiculata	Nematoda	*M. incognita, M. javanica, M. arenaria*	R	A, E	(McSorley, 1999 ; Regnault-Roger et al., 2002)
	Insecta	*C. partellus, Chilo orichalcociliellus, Sesamia calamistis*	S, L	A, G, K	(Skovgard and Pats, 1997)
V. villosa	Insecta	*D. radicum, P. xylostella*	S, L	Unknown	(Dixon, 2007; Mangan et al., 1995)
	Nematoda	*M. arenaria, M. artiellia*	R	A	(El Moneim and Bellar, 1993; Mosjidis et al., 1993)
S. guianensis	Nematoda	*M. incognita, M. javanica, P. brachyurus*	R	A	(Luc et al., 2005 ; Regnault-Roger et al., 2002)
Trifolium sp.	Nematoda	*M. trifoliophila*	R	A	(Barrett et al., 2005 ; Mercer et al., 2004)
	Insecta	*Heteronychus arator*	R	C	(King et al., 1981)
A. sativa	Nematoda	*Meloidogyne spp.*	R, S, L	B	(Regnault-Roger et al., 2002)
	Insecta	*T. myopaeformis*	S, L	H, K	(Dregseth et al., 2003)
	Acarina	*Oligonychus punicae, Scirtothrips citri*	S, L	D	(Bugg, 1991)
Brachiaria sp.	Nematoda	*M. incognita, M. javanica*	MD	Unknown	(Dias-Arieira et al., 2003 ; Regnault-Roger et al., 2002)
C.dactylon	Nematoda	*M. incognita*	MD	A	(Johnson et al., 1995)
	Insecta	*Spodoptera frugiperda*	MD	Unknown	(Jamjanya and Quisenberry, 1988)
E. coracana	Nematoda	*R. reniformis*	R	A	(Asmus et al., 2008)
L. multiflorum	Nematoda	*R. reniformis*	MD	Unknown	(Jones et al., 2006)
	Insecta	*L. phyllopus*	MD	Unknown	(Bugg, 1991)
R. sativus	Nematoda	*H. schachtii, M. incognita, M. halpa, R. reniformis, Trichodorus sp., Pratylenchus sp.*	R	A, E	(Crow et al., 2001 ; Cuadra et al., 2000; Kokalis-burelle and Rodriguez-Kaban, 2006 ; Regnault-Roger et al., 2002 ; Rodriguez-Kabana et al., 1992)

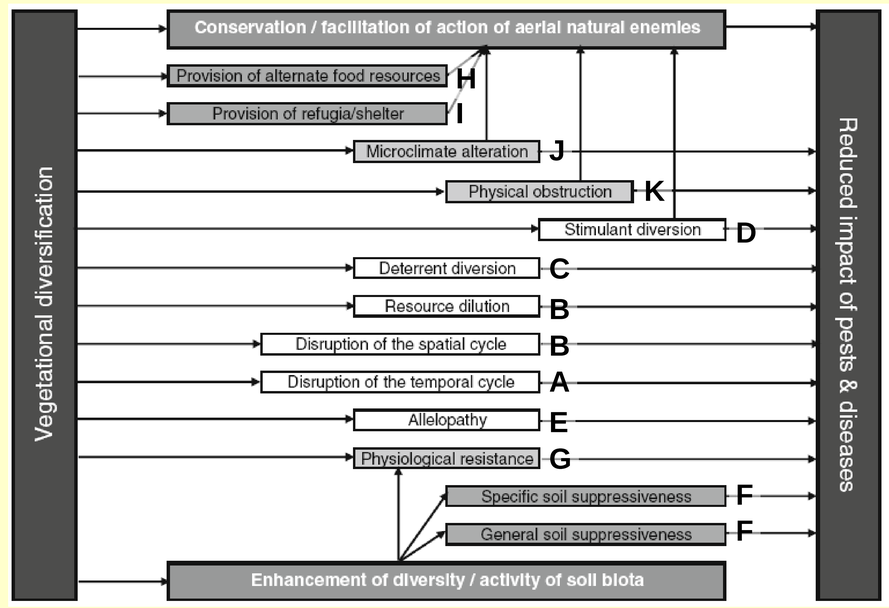

Figure1: Major pathways for reducing the impact of pests and diseases via the introduction of plant species diversity in agroecosystems (adapted from :Ratnadass et al., 2010),

Result and discussion

Only one article reports effects of a plant on a black beetle: *Trifolium repens* on *Heteronychus arator* (King et al., 1981). Some articles report effects on various insects while most of the references document effects of plants on nematodes (Table I). It was therefore concluded that in view of the high endemism in Madagascar and the lack of references on the potential effects of plants on pests in the Malagasy context, these effects should be tested locally. The selection of plants can focus on plants reported elsewhere as the most effective against nematodes, which may be indicative of the production of biocide molecules with a broader spectrum. Very few studies have been conducted on nematodes in Madagascar (Villenave et al., 2010). Studies require specific knowledge and thus, the effects of plants on nematodes are largely underestimated when evaluating the cropping systems. Thus, much remains to be done to precisely assess the effects of cover crops on soil macrofauna in general, and more specifically on pests. Such work is needed for better design and evaluation of new CA cropping systems. Up to now, the effects of cover crops on pests have been underestimated as compared to more visible effects such as weeds and erosion control (Séguy et al., 2009), and the ability of cover crops to reduce pest incidence is still underused.

References

You can find the abstract with full references list in the congress proceedings, on the following web page: http://agents.cirad.fr/index.php/krishna.naudin/Pest_control_CA, or by scanning the QR code :